

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
196	Nursing Care	805	In 1996 this nursing care facility strengthened its ergonomics program directed at the risks associated with the lifting of patients. They brought new mechanical lifting equipment into use in the facility and began an intense training program covering the use of both the equipment and proper procedures for making safe lifts. They also implemented a progressive disciplinary program to ensure the new policies were observed.	Cut the number of lost workday injuries from 473 to 16.	By strengthening their ergonomics program in 1996, this nursing care facility reduced their rate of related occupational injuries from 1995 to 1997 by more than 75%.	OSHA case files (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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146	Health Care	805	In June of 1997 the company established a no-lift policy. The program is called Get A Lift Workplace Program by Prevent, Inc. In the program each resident is assessed for the need for mechanical lift assistance and for the type of lift indicated (MAXI or SARA). The facility has two MAXI lifts and two SARA lifts. Color coded stickers are used to denote the type of lift to be used. The stickers are applied to the resident name plates outside the room. The staff is trained on both types of lifts. Use of lifts is strictly enforced. Management had initial problems with staff acceptance, but is pleased with their buy-in now.	Although it was already half way through 1997 when the company strengthened their ergonomics program, their rate of lost time injuries and the number of associated lost workdays were both still down by 50% for the year, compared to 1996 levels.	Not Reported	OSHA case files (Ex: 502-22)
145	Health Care	805	The company significantly strengthened their ergonomics program in 1997. They instituted a no-lift policy (exceptions are made for some patients due to their families' objections) and added mechanical lift assists to their facility. Training was provided to their staff on the use of the new equipment and safe lifting techniques.	Not Reported	After implementing an ergonomics program in 1997, this small health care facility achieved a 50% reduction in their related injury experience.	OSHA case files (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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227	Nursing Care	805	In 1996 this facility implemented an ergonomics program. Mechanical lift assist devices were purchased and put into use. The staff received training on the new equipment and the procedures for performing lifts safely. A medical management program stressing early reporting of pains and symptoms was instituted.	In the first year following the implementation of an ergonomics program in 1996, this facility reduced their ergonomics-related lost-time injuries by two thirds, and the lost days associated with them from 748 to 111.	Not Reported	OSHA case files (Ex: 502-22)
101	Nursing Assistants, Nursing Home	805	Implemented program to determine patient lifting tasks that were the most stressful; evaluated alternative devices for acceptability among assistants; trained assistants in use of devices; and modified shower rooms and patient care techniques to facilitate patient handling. Used walking belts and mechanical hoists for lifting aids.	Decrease from 634 lost workdays/100 FTEs before intervention to 317 lost workdays/100 FTEs post intervention.	Incidence for back injuries decreased from 83 to 47 per 200,000 work-hours.	Garg and Owen (undated) (Ex: 26-1093) (Ex: 37-5)
102	Nursing Aides, Nursing Home	805	Committee of employees determined the types of mechanical devices that were needed, installed in 1993. Implemented employee training and modified duty programs.	Decrease in lost work days from 38 in 1991 to 4 in 1994 (as of Nov), largely attributed to the implementation of a no-lifting greater than 50 pounds policy.	Not Reported	Comments to OSHA from Kennebec, (undated) (Ex: 26-1094)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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243	Nursing Care	805	This facility decided to start an ergonomics program, including an ergonomics training program that emphasizes proper lifting and transfer techniques. Powered lift assists have been purchased and put into use. Two part time physical therapists provide ergonomic support to the nursing staff. Review of ergonomics related incidents and refresher training have been added to their program.	In the first year (1998) following initiation of their ergonomics program, this small nursing care facility cut their occupational injury rate by a third and their lost/restricted work-days by over 50%.	Not Reported	OSHA case files (Ex: 502-22)
194	Nursing Home	805	In 1996 they established an ergonomic component of their overall safety program aimed at primarily the handling of residents and office ergonomics. They focused on an employee-driven program with a strong training emphasis. They added electronic patient lifts to their stock of hydraulic lifts.	They have had a dramatic reduction (over 50%) in their lost-time ergonomic injury incidence and severity rates. They have saved over \$100,000 in direct injury costs in the last four years. They have improved their continuity of resident care and the morale and pride of their employees.	Not Reported	Sherry Welch, Citizens Memorial, Bolivar, MO Phone call 7/13/99 (Ex: 502-22)
138	Nursing Care	805	The facility purchased a new Hoyer Lift and established a safety initiative program.	Compared with 1997 rates, the facility in 1998 cut their incidence of total lost time injuries and back injuries by over 50%. The severity of those injuries was also greatly reduced.	Not Reported	OSHA case files (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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236	Nursing Care	805	In 1997, this facility established an ergonomics program. They abolished the practice of single person lifts and instituted the use of gait belts. Their physical therapy department evaluated the handling requirements for each resident and provided this information to the nursing staff.	By instituting an ergonomics program in 1997, this small nursing-care facility was able to cut their rate of ergonomics related injuries in half in each of the succeeding two years and cut the associated lost work days by more than 90%.	Not Reported	OSHA case files (Ex: 502-22)
316	200- Bed Acute Care Facility	805	Use a specialized "Lift Team" for lifting of patients which is specially trained for this task. Also, use of mechanical equipment.	In 1996 & 1997, had 11 and 9 reported lost time injuries, 23 and 31 lost days, with a cost of \$20,632.00 and \$63,796.00 respectively. In 1999, the year of implementation, had only 2 reported injuries with no lost days and 2 restricted days with a cost of \$336.00	Not Reported	(Ex: 32-311-1-8)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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136	Health Care	805	In 1997 the company began an aggressive ergonomics training/in-service program. They provide gait belts for each nursing employee. There are three mechanical lift devices located throughout the facility and the lifting techniques and proper lifting training given during orientation and frequent in-service training are administered by the physical therapy and rehabilitation staff. This training includes critiques of staff actually performing transfers from wheelchairs and floor situations.	The severity of injuries that did occur after program implementation, as reflected in the number of lost working days associated with them, was down significantly.	After aggressively training their staff in the ergonomics of proper lifting techniques in 1997, this employer's incidence of related back injuries and upper extremity musculoskeletal disorders in 1998 was reduced by 80% from their 1996 experience.	OSHA case files (Ex: 502-22)
117	Nursing Home	805	The nursing home implemented a federally-funded injury-prevention project with UCLA's Occupational Safety and Health Program. Vale Health Center established a labor-management committee to review injury problems. It purchased old patient-lifting equipment with easier-to-use electrically powered lifts. Nursing aides also attended injury-prevention training sessions.	Not Reported	The company reduced back injuries from 10 per year to only one during the first six months after implementation of the ergonomics program.	<i>Los Angeles Times</i> , (July 25, 1997) (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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296	Health Care Facility	805	Hospital-wide quality management initiative that included an ergonomics -based back injury prevention program involving mechanical lifting devices.	Workers' compensation costs for back injuries were reduced from \$174,412 to \$4,500. Lost work days were reduced from 1025 to 81.	They achieved a 74% reduction in back injuries over a 3-year period.	Testimony of Guy Fragala, PhD., PE, CSP. (Ex. 37-4)
237	Nursing Care	805	At the start of 1997 this facility established an ergonomics program. Their physical therapy group was assigned responsibility for analyzing the handling requirements for each resident and providing this information and training to their nursing staff in the biomechanics of proper lifting and newly established policy on resident lifts. Single person lifts were prohibited and mechanical lift assists made available.	Since instituting their ergonomics program early in 1997, this small nursing-care facility reduced the number of lost workdays by over 85% over the next two years.	Since instituting their ergonomics program early in 1997, this small nursing care facility over the next two years cut their number of ergonomics related injuries by two thirds.	OSHA case files (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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129	Health Care	805	<p>The facility asked Colorado Compensation Insurance (CCIA) to evaluate the worksites for affected employees. CCIA compiled data on injuries that met six criteria:</p> <ul style="list-style-type: none"> *The injury occurred at the facility *The injury occurred in 1995 *The injured worker was in a clerical, administrative function *The injury was caused by a cumulative trauma to the hand, wrist, arm or neck *The injured person received physical therapy *The injury did not become a lost time case within 30 days from the date of the injury report (a lost time case is defined as one resulting in 3 or more days away from work). 	<p>Of the cases receiving interventions, only 5 resulted in lost-time cases; the remaining 67 were non-lost time cases. Of these 72 cases, the average cost per case was approximately \$2,959. The cases that did not receive interventions cost approximately \$4,652 per case.</p>	Not Reported	<p>Patricia Fernberg, "Health Returns from Ergonomics," <i>Occupational Hazards</i>, (10/1/98). (Ex: 502-22)</p>

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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322	Three Nursing Homes	805	Implemented a zero-lift policy.	Achieved an: 80% reduction in lost or restricted workday injuries from patient transfers; 62% reduction in all lost or restricted workday injuries; and, 80.6% reduction in worker compensation cost from nursing departments and a total reduction of 75% per hospital. The number of lost or restricted workdays per year decreased 84.6%.	Not Reported	(Ex: 30-4779-1)
126	Nursing Care	805	Beginning in 1996, this employer implemented a good ergonomics program. They began a "no unassisted lift" policy. A body mechanics and lifting training program was added. All staff were provided with gait belts and training on their use. Mechanical lift assists were also purchased for each nursing wing and the bathing facility and put into mandatory use.	The company's LWDII rate fell from 35.8 in 1996 to 16.2 in 1997.	The facility implemented an ergonomics program in 1996 and was able in the first year to achieve a 50% reduction in their rate of associated workplace injuries. The severity of the injuries that are occurring is also decreasing.	OSHA case files (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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125	Nursing Care	805	In 1996 when new management took over this nursing care facility a decision was made to strengthen the ergonomics program, especially as it related to back injury prevention. Training in safe lifting techniques and back biomechanics was provided. An additional mechanical lift for resident transfers was purchased and put into use.	By strengthening their ergonomics program in 1996, this employer cut their rate of related lost-time injuries in half in 1997.	Not Reported	OSHA case files (Ex: 502-22)
195	Nursing Care	805	This facility began to implement an ergonomics program in 1995. An ergonomics consultant from Healthline assisted with pre-assignment job screening and defining the management and staff responsibilities for implementation of the new program activities. The administrator reviews all accident investigations to ensure causal factors and corrective actions are identified and implemented. There is a modified/restricted duty program in place. There are mechanical lifts available in all three divisions. A training program has been established covering the proper use of lifting equipment and lifting techniques. Unassisted lifts are prohibited.	Not Reported	From 1995 to 1997, the ongoing implementation of this nursing care facility's ergonomics program resulted in a 50% reduction in both the rate of back injuries incurred by its staff nurse aides and the lost work-day rate associated with those injuries.	OSHA case files (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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359	Nursing Care	805	They purchased various new lifting devices and made their use mandatory. Extensive training on proper use of equipment and patient handling.	Reduced the overall total lost time injury and illness rate by 75% between 1996 and 1998.	Lost-time back injuries and upper extremity MSDs declined from 9 to 2 cases between 1996 and 1998. The lost-work-day injury incidence rate for certified nurses aides declined from 20.3 in 1996 to 5.9 in 1998.	(Ex. 502-404)
363	Nursing Care	805	They purchased and put into use mechanical patient lift assists. Training on lifting is mandatory.	Reduced the total lost-time injuries and illnesses by approximately 50%.	Reduced the number of back injuries and upper-extremity MSDs by approximately by 50% between 1996 and 1998.	(Ex. 502-404)
365	Nursing Care	805	Implemented an ergonomics program that included thorough job safety hazard analysis, extensive employee training, and a strong back to work rehabilitation policy.	After implementing an ergonomics program in 1996 they had a 95% decrease in lost work days associated with ergonomic-related injuries.	As of May 1998, they have had only one recordable back injury with one lost work day.	(Ex. 502-404)
375	Nursing Home	805	They established a no-lift policy and purchased the mechanical lift equipment and established an ergonomics training program to support proper implementation and use of the new equipment.	In the second year after establishing a new comprehensive program, they achieved a 75% reduction in lost work-days.	In the second year after establishing a new comprehensive program, they achieved a 68% reduction in workplace injuries.	(Ex. 502-404)
360	Nursing Care	805	They made lifting equipment available on all resident floors and prohibited the use of single-person lifts. Also yearly in service training about patient handling and body mechanics.	Reduced the number of lost work-days from 170 in 1996 to 124 in 1997 and 44 in 1998.	Reduced the number of total lost-time-back injuries and upper extremity disorders from 7 in 1996 to 2 in 1997 & 1998.	(Ex. 502-404)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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338	Long Term Care Facility	805	Ergonomics-based back-injury prevention program, including lifting devices.	Over 3-year period lost-work-days reduced from 1025 to 81. Workers' compensation costs reduced to \$4,500 from \$174,412.	A 74% reduction in back injuries over 3 year period.	(Ex. 500-47-10)
374	Nursing Home	805	A "no-lift policy was established that required nursing personnel to use new mechanical lifts for lifting all residents. Training was provided on the ergonomics of lifting as well as on the new lifts.	In the first year following the implementation of their program, their total workers' compensation costs reduced from \$19,000 to \$118.	In the first year following the implementation of their program, their back injury claims related to sprains and strains were reduced from twelve to one.	(Ex. 502-404)
366	Nursing Care	805	The program addresses training, personal protective equipment, engineering control methods and medical monitoring.	The ergonomics program at this mid-sized nursing care facility reduced the rate of total lost time injuries and illnesses by 40% between 1996 and 1998.	The ergonomics program at this mid-sized nursing care facility reduced the number of back injuries and upper extremity MSDs by 40% between 1996 and 1998.	(Ex. 502-404)
344	Nursing Home	805	Instituted a joint labor-management back-injury prevention program. Consists of 10 members covering different shifts, and is co-chaired by the staff developer and shop steward. Additional equipment became available. Awareness training for LVNs was conducted.	Not Reported	Incidence rates remained relatively unchanged between 1996 and 1997 however, severity rates went from 143 in 1996 to 64 in 1997 per 100 worker-years. The severity rate for all musculoskeletal strain/sprain type injuries went from 196 to 89/100 worker years.	(Ex. 500-20-5)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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315	10 Hospital Study	806	A special "Lift Team" was developed utilizing specially trained and skilled people for lifting only. Trained for 2 days (16 hours) in latest techniques and equipment. Also included use of new mechanical lifts.	All 10 facilities showed a mean reduction in lost-work-days of 90%.	All 10 facilities showed a mean reduction in back injuries of 69%, and incidence rates of 62.5%.	(Ex: 32-311-1-3) (Ex: 38-119)
298	Hospital	806	High risk processes were identified and priorities set for ergonomics interventions. Two high-risk units were identified and new lifting devices were instituted.	* Lost work days for one unit were reduced from 69 to 0 and restricted work days from 122 to 2. * Lost work days for the other unit were reduced from 48 to 0 and restricted days from 11 to 4.	* One unit achieved an 83% reduction in the number of occupational injuries. * The other unit achieved a 75% reduction in the number of injuries.	Testimony of Guy Fragala, PhD., PE, CSP. (Ex: 37-4)
292	Hospital	806	Implemented training and work practices, which included standardization of lifting procedures, an apprenticeship program for new workers, and use of mechanical lifting and transfer aids.	In 2 years, achieved a 74% decrease in lost time injury. Total lost days decreased from 136.2 to 23 per 100 FTE. Compensation costs decreased from \$ 237/FTE to \$139/FTE.	In 2 years, there was a 50% decrease in total OSHA recordable's.	Testimony of Bradley Evanoff, MD, MPH. (Ex: 37-1)
340	Hospital	806	Implemented lifting aids on two high risk units.	Lost-work-days were reduced from 69 to 0, and restricted days reduced from 133 to 6.	Occupational injuries improved approximately 80%.	(Ex: 500-47-10)
341	Hospital	806	Instituted a no-lift policy.	Not Reported	Reduced injuries by 95%.	(Ex: 500-47-10)
299	Hospital	806	Ergonomics program included the development of a no-manual-lifting policy with standardized lift and transfer procedures for patients.	Not Reported	Injuries were reduced by 95%.	Testimony of Guy Fragala, PhD., PE, CSP. (Ex: 37-4)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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304	Hospital	806	A comprehensive ergonomics system was implemented which included items such as patient assessments, purchase of assistive devices, education and training, new management policies for workers to follow, monitoring of the program, and management support.	Initially, there were 64 lost work days and 15 transitional or restricted days. 18 months later there were 3 lost work-days and 12 transitional days. 5 years later, there were no lost work-days.	Initially, there were 20 back or shoulder injuries, 18 months later that was reduced to 12 (40%).	Testimony of Bernice D Owen, PhD, RN (Ex. 37-5)
301	Hospital	806	Ceiling-mounted lifts were installed in a 200-bed facility.	Hospital was experiencing 26 lost-time injuries per year, based on 4 years of data, with an average of 938 lost days per year. In 2 years since new lifts were introduced, injuries dropped to 6.5 per year and lost days to 67 per year.	Not Reported	Testimony of Guy Fragala, PhD., PE, CSP (Ex. 37-4) (Ex. 500-47-10)
302	Hospital	806	Ergonomics management program and engineering control intervention were implemented. Mechanical lifting devices were installed.	In 1990, they experienced 1,097 lost-work-days. By 1995 they had reduced lost-work-days to 48.	Not Reported	Testimony of Guy Fragala, PhD., PE, CSP (Ex. 37-4)
297	Hospital	806	Quality improvement team determined that effective patient handling devices were needed as part of their intervention strategy. Started using lifting equipment.	Annual direct costs associated with back injuries resulting from patient handling based on an average of 3 years was \$111,159. One year after new mechanical devices were introduced this was reduced to \$743.	Not Reported	Testimony of Guy Fragala, PhD., PE, CSP. (Ex. 37-4)

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293	Hospital	806	Changes were made to billing office persons' workstations such as adjustments to computer keyboards and monitor setups and adjustments in seats and desks layouts.	Annual total days declined from a rate of 51 days per 100 FTE to 25 per 100 FTE. Compensation costs decreased from a high of \$578 per FTE to a low of \$120 per FTE.	Not Reported	Testimony of Bradley Evanoff, MD, MPH. (Ex. 37-1)
288	Hospital Employees	806	Implemented a comprehensive intervention that included case management, treatment by physicians experienced with work injuries, and use of ergonomic work.	A decrease in time lost from 10.4 to 6.6 days, and a 18% reduction in total case cost.	A decrease in musculoskeletal injuries. Further, the program resulted in a pronounced decrease in the number of work-related upper extremity MSDs and a virtual elimination of cases which required surgery.	Testimony of Bradley Evanoff, MD, MPH. (Ex. 37-1)
317	Hospital/nursing	806	Use a specialized "Lift Team" for lifting of patients which is specially trained for this task. Also use of mechanical equipment.	They went from 39 cases per 1000 year observation to 2.4 cases per 1000 year observation. A 95% reduction in lost time injuries.	Not Reported	(Ex. 38-42)

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382	750-Bed Medical Center	806	In 1993, a comprehensive ergonomics program using the 5 step approach was implemented. One component of their program was the implementation of an ergonomics team with representation from each of the major departments.	These efforts were a part of the reason for the reduction in lost-work-day incident rate from 5.9 to 4.0 for calendar year 1993 to 1994. Their lost-work-day incident rate continue to improve, reaching 3.3 in 1997. This compares to an industry average for hospitals in 1997 of 4.1. They went from significantly worse than industry average to significantly better.	Not Reported	(Ex. 500-50-1)

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255	Hospital	806	Initiated a comprehensive ergonomics program in 1992. The program consisted of early diagnosis and treatment of upper-extremity MSDs along with identification and correction of problem jobs. The program emphasized early detection of problems by providing that any worker with a complaint that could "possibly" be related with an upper-extremity MSD was medically evaluated and an ergonomic survey/job analysis of the employee's workplace was conducted to determine the work-relatedness of a potential worker's compensation claim and to initiate corrective action.	Not Reported	In the seven-year period following the 1992 initiation of this ergonomics program, the rate of upper-extremity work-related MSDs decreased significantly by 80 % from 6.5 per 1,000 in 1992 to 1.3 per 1,000 in 1998.	Appendix C "Summaries of Studies on Effective Ergonomics Programs and Interventions" (Bernacki et al., 1999) (Ex:32-339-1)
103	Nurse, Hospital	8062	Professional lifting team of 2 performs 95% of all patient lifts; nurses freed to do more nursing activities.	Not Reported	Back injuries reduced 94% first year after teams were implemented	Charney et al. (1991) (Ex. 26-1091)

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104	Nursing and Laundry Workers, Hospital	8062	Worker education and training were provided. Employees were encouraged to take breaks. A regular maintenance program for equipment was initiated. New hand tools and lifting equipment were provided. Handles were installed on tool carts. X-Ray cassettes were reorganized to avoid repetitive bending and back problems.	Lost-time hours in nursing ward fell 83 percent in 4 years. Lost-time hours among laundry workers fell 83 percent in 2 years.	Back injury rates in nursing wards fell 39 percent in 4 years. Back injury rates among laundry workers fell 71 percent in 2 years.	"Giving health-care workers a helping mechanical hand." CTD News (1995) (Ex. 26-1092)
385	Hospital	8062	Steps involved in the process: 1. Define the exposures; 2. Identify the location and severity of negative results; 3. Identify existing and previously reviewed equipment to address exposure; 4. Determine new equipment and work practice needs	One facility's results: -reduced-lost-time cases from 43 to 7 over a two-year period. -productivity went up -reduced workers' compensation from \$80,000 to \$15,000	Not Reported	(Ex. 500-50-1)
384	450-Bed Hospital	8062	Applied the five-step approach and recognized that patient transfer was the primary loss-producing source that needed to be addressed.	These efforts resulted in a reduction in lost-work-days per 100FTE from 43.7 in policy year 92/93 to 20.5 in policy year 94/95.	Not Reported	(Ex. 500-50-1)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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106	Prescription Filling Using a Syringe, Hospital	8062	A manual assist for syringe actuation was developed to reduce the thumb and pinch grasp forces required while using a standard syringe. The system, about the size of a hot dog bun, accommodates standard syringe sizes from 10cc to 60cc.	Not Reported	Upper extremity CTD cases were reduced from six to one.	"Case study 60: Hospital pharmacy liquid IV prescription filling using a syringe." ErgoWeb Inc., 1998 (Ex. 26-1096)
107	Hospital Workers	8062	Patient Air Lift Systems introduced.	Not Reported	Reduced injuries at second hospital by 94%.	Brigham (1994) (Ex. 26-1097)
108	Nursing, Hospital	8062	Redesigned work process: Mechanical lifting equipment, slide boards, and patient transfer belts.	Lost-time injuries reduced to 49 (down 35%), with 426 lost days (a 57% decrease), and 1,851 restricted days (a 54% decrease).	In 1994 total back injuries decreased to 85 (a 43% reduction)	Hospital Employee Health (1995) (Ex. 26-1098)
383	230-Bed Hospital	8062	Implementation of an ergonomic program including the purchase of 13 Air-supplied mattress (i.e., transfer technology) devices.	The total cost for the devices was \$22,000. The cost for patient transfer related incidents the two years prior to introduction was \$272,380. The cost for the two years immediately following intervention was \$73,117, a reduction of almost \$200,000.	Not Reported	(Ex. 500-50-1)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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105	Nursing, Hospital	8062	Ergonomic assessment of 14-room surgical suite, implemented changes in procedures for moving patients, maneuvering carts and equipment, using gall bladder boards, walking on wet floors, and accessing power outlets. Workers are periodically retrained in procedures to maintain awareness.	Not Reported	Back injury rates reduced by 25% in 18 months since program was implemented.	Garg and Dockery (1995) (Ex. 26-1095)
345	Medical Center	8062	Interdisciplinary team established to prevent injuries and reduce workers compensation costs. Ergonomics team divided into three components, 1) Basic Ergonomics, 2) Medical Ergonomics, 3) Human Factor Engineering.	Workers' compensation claims were reduced from 10.49 per 100 FTEs in 1995 to 7.26 in 1999.	Not Reported	(Ex. 30-4139)
346	Hospital Billing Department	8062	Ergonomics program was conducted. Jobs selected that needed attention, employees were trained, and job modifications and equipment changes made (i.e. desk and chair heights, back support, foot and wrist rests, etc.).	Annual workers' compensation cost were reduced from \$578/FTE to \$120/FTE. Lost work-day injury/illness rate dropped from 63.2/100 FTE to 6.4/100 FTE. Annual lost work-days was reduced from 51/100 FTE to 25/100FTE.	The number of work compensation injuries was reduced from 12/100 FTE to 5.4/100 FTE.	(Ex. 30-4139)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

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172	Home Health Care	8082	The ergonomics program established by this employer relied heavily on training. This included training on back biomechanics and safe lifting techniques. They constructed a mock home health care setting at their training facility to allow hands-on practice.	Cut their workers' compensation costs by 50%.	Not Reported	OSHA case files (Ex: 502-22)
167	Educational Institution	82	They established an ergonomics assessment and implementation team to analyze their injury and illness data and identify when, where, and how their injuries were occurring. The ergonomic concerns they identified were addressed with job redesigns, equipment changes, training, and warm-up exercise programs. They stressed employee involvement in all phases of their program.	Three years after being invited to join the Maine 200 Pilot program this institution's ergonomics program had reduced their lost work-day injury rate and total lost work-days by over 95%. Their workers' compensation insurance costs had decreased by over \$100,000 per year.	Not Reported	OSHA case files (Ex: 502-22)
342	Health Science Center	8733	Ergonomics program, lifting aid devices, staff training on device use.	Lost time hours have dropped 43%.	Back injury incidence rates have fallen 23%.	(Ex: 500-47-10)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
119	Municipality	91	Under one of San Jose's ergonomics programs, a job is analyzed over a number of days to identify high-risk activities. A training session was created to show workers how to work differently to reduce the risk of injuries. Aside from the specific instructions, the six-hour course also provides more general information on body mechanics, posture and breathing. Another program teaches employees proper typing techniques designed to reduce repetitive stress injuries. Finally, San Jose has made several improvements to employee workstations, including split keyboards and track balls instead of mouse.	The ergonomics program has helped save the city \$5.7 million in workers' compensation costs since 1995.	In Fiscal Years 1996-1997, back injuries among city workers fell by 57.3%, while wrist injuries fell by 25.9%.	Michael Bradford, "Ergonomic Changes Comfort San Jose: Efforts to Reduce Workplace Injuries Save Millions and Help Workers Stay on the Job," <i>Business Insurance</i> , 10/26/98, (Ex: 502-22) (Ex: 32-339-1-66)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
229	Government	91	The State recognized the need for a statewide comprehensive ergonomics program with management commitment and employee involvement. Employees on the assessment teams recommended changes to the workstations such as adjustable chairs, document holders, wrist and mouse rests, footrests and adjustable height keyboard holders. For some workstations, no equipment was needed, but the assessment team recommended short breaks from keying. Another important component of the ergonomics program was training. Training on ergonomics was provided for employees and supervisors.	In the first two years, the ergonomics program decreased the cost associated with MSDs by 51%, and the cost has continued to fall. In 1998, Wisconsin had a 75% decrease from levels at the start of the program.	Not Reported	<i>Occupational Safety and Health</i> , (August 1998). (Ex: 502-22)
109	Government Employees	91	Introduction of program of ergonomic improvements, education, training, and physical fitness activities.	Not Reported	1-year prevalence of back pain fell from 65 to 53 percent.	Shi (1993) (Ex: 26-1099)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
349	VDT Operators		A committee was formed to identify alternative work patterns to increase work variability, reduce the amount of keying to no more than 5 hours per day, and evaluate new chairs. New chairs installed in February, 1991.	Not Reported	CTDs for Nov. 90 Feb. 93 Neck 22.2% 0.0% Shoulder 13.9% 14.7% Elbow/ Forearm 8.3% 5.9% Hand/ Wrist 36.1% 20.6% Low Back 8.3% 0.0	(Ex: 500-41-115)
274	Household Products Manufacturer		Introduced adjustable workstations, improved the grips on hand tools, improved parts organization and work flow.	Not Reported	Reduced all injuries (particularly back) by 50%.	"Summary of Studies on the Effectiveness of Ergonomic Interventions" (June 1995). (Ex. 38-65)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
204	Military		Identified a comprehensive program to address ergonomics base-wide. They established an ergonomics committee to identify workplace ergonomic stresses from their injury logs and to evaluate those high risk areas to prevent future injuries. Powered ergonomic tools were substituted for mechanical models. Task lighting was improved. Storage spaces were rearranged to eliminate bending and lifting. Electric lift tables and hoists were added. An ergonomics training program was put into place to help workers identify and minimize ergonomically stressful activities. The base's occupational medicine program was strengthened in its approach to workplace ergonomics.	Not Reported	Four years after establishing a comprehensive, practical and modestly funded ergonomics program, a high rate of ergonomic injuries were eliminated.	CTD News, (January, 1996), (Ex: 502-22)
373	Manufacturing-raw Material Processing		During 1989 thru 1991, the company purchased 27 electronic lift assists that it permanently mounted on its lift trucks.	Not Reported	Reduced the number of back injuries from 13 to 4 over a two-year period while improving product quality.	(Ex. 502-404)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates			Sources
				Lost Workday MSDs	Total MSDs		
188	Manufacturing		<p>The company developed a comprehensive ergonomics program, including the following:</p> <ul style="list-style-type: none"> *An education program, including videotapes, seminars and instruction on proper posture, designed to teach computer users how to reduce exposure to ergonomic injuries. *A site on 3M's company intranet with information designed to help employees evaluate their workstations. *The development of new products, including a gel-filled wrist rest for computer users. *Using forklifts and "tote tanks" instead of manually maneuvering 55-gallon drums. 	At one plant, lowered incidence of lost workdays from more than 50 days per 100 workers in 1991, to less than 20 days per 100 workers in 1994.	A study of 1,000 company employees over a 30-month period revealed that less than 11% still reported pain or discomfort after implementing all or part of the recommended ergonomics changes.		<p>Profiting From Loss Control: 3M's Own Ergonomics Research Leads to New Products, <i>Business Insurance</i>, 4/27/98;</p> <p>"Ergonomics Teams: Help Workers Help Themselves" <i>Safety & Health</i>, (2/96, pp. 55-56).</p> <p>(Ex: 502-22)</p>
212	Manufacturing - Materials		The company established a very aggressive safety program and an ergonomics program. The company installed a lift to move 600-pound drums and purchased an auto-pallet loader to further minimize lifting and moving.	In 1996, the company had reduced its workers' compensation claims to 1,000 from 2,500 in 1987.	Not Reported		Company report to OSHA (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
333	Military		Implemented abatement program focused on tasks requiring excessive lifting, bending and repetitive arm motions centered around a joint labor management team for identifying hazards. Workers are trained and a medical monitoring program was developed.	Not Reported	RSI exposures at the plant have dropped dramatically. RSI injuries in the parachute shop have essentially been eliminated. In four-year period prior to the program, 15 of 25 employees in the shop had been diagnosed with RSIs.	(Ex: 32-339-1-1)
311	Manufacturing		Redesigned totes for carrying of large and small parts to reduce cumulative wrist trauma disorders from repetitive lifting and maneuvering.	Not Reported	3 serious wrist cumulative-trauma disorders had occurred in the 4 years since the introduction of the new totes, they have not had one wrist cumulative-trauma disorder.	(Ex: 500-114)
268	Cable Forms Production		Introduced adjustable workstations and fixtures, counterbalanced tools.	Reduced musculoskeletal sick leave by 67% over an 8-year period, productivity increased.	Not Reported	"Summary of Studies on the Effectiveness of Ergonomic Interventions" June 1995 Ex: 38-65

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
115	Administrative Services		Work areas were evaluated for potential ergonomic risk factors and recommendations for engineering controls were made and implemented. In addition, a medical management program and an office ergonomics training program were established.	The number of hours lost due to occupational injury was reduced by 75%.	No new injuries were reported in the first year following full implementation of their program.	CTD News, (January 1998) (Ex: 502-22)
254	Gov't. Employees		Workers are trained in ergonomic practices and tracked to determine whether the program has been successful in reducing work related MSDs. The department incorporated hand-powered, portable lifting devices, tire-dunker machine, automated lubrication systems, etc.	During two-year period, reduced the number of lost work days from 225 to 68 (70% reduction).	During two- year period, reduced the number of MSDs from 86 to 39 (55% reduction).	"Ergonomics at the DoN" (Ex. 192)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
259	Computer Manufacturer		In 1991, this company initiated an ergonomics program incorporating a number of core elements, including management commitment, training, medical management, identification of high risk employees, hazard analysis and control.	During the period 1994 through 1998, OSHA recordable cumulative trauma disorder rates decreased in each of the four years, days away from work per lost day case declined from 14.67 in 1994 to 4.1 in 1998, a 72% decrease in the time away from work for each lost day case, and an avoidance of approximately 20,000 days away from work over the four-year period, accounting for more than \$10 million in direct and indirect savings.	Not Reported	Appendix C "Summaries of Studies on Effective Ergonomics Programs and Interventions" (Ex:32-339-1)
381	16 Separate Companies and Consisted of a Wide Range of Materials Handling Jobs.		Intervention types included: 1. Lift tables 2. Lift aid 3. Redesign 4. Equipment	Not Reported	Ergonomic interventions consistently reduced the jobs' mean low back incidence rates.	(Ex. 500-87-1)
273	Office		Provided training, redesigned workstations, and incorporated additional breaks and exercise into the work schedule.	Average of all sick leave decreased from 20 days/year to 10 days/year in two years.	Not Reported	"Summary of Studies on the Effectiveness of Ergonomic Interventions" (June 1995). (Ex. 38-65)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
260	Office Setting		Initiated an ergonomics program in the late 1980's focused on an office environment. Their program incorporated a number of the core elements of a programmatic approach, including training, management commitment, job hazard evaluation and control, medical management, hazard identification and a pro-active element (engineering out hazards before equipment is put in place).	Total MSD claims severity (monies paid for MSDs) dropped despite an estimated 15% per year increase in medical costs. In addition, MSD claims payouts as a percent of total workers' compensation payouts declined from 66% of total dollars paid in 1992 to 48% of dollars paid (projected) in 1997.	Not Reported	Appendix C "Summaries of Studies on Effective Ergonomics Programs and Interventions" (United Services Automobile Association). (Ex:32-339-1)
267	Various (Insurance Co. Survey)		Program included training in lifting techniques, design of lifting tasks to fit worker capabilities.	Not Reported	Matching job demand to worker capabilities reduced injuries by 67%. There was a decrease of 33% in back injuries.	"Summary of Studies on the Effectiveness of Ergonomic Interventions" (June 1995). (Ex. 38-65)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
159	Television Assembly		The company initiated a four-step plan to eliminate WMSDs: Identify high risk tasks; educate managers and workers on proper ergonomic methods; adopt modified tools and redesign workstations; and institute mandatory job rotation. Mandatory job rotation proved to be the most effective method for preventing WMSDs.	Not Reported	The company experienced a 46% reduction in WMSDs during the first nine months following partial implementation of job rotation. Another study showed workers on mandatory job rotation lines suffered nine WMSDs during a four-month period compared to 42 for workers on lines where rotation was optional.	Job Rotation Cuts Cumulative Trauma Cases," <i>Personnel Journal</i> , (February 1992). (Ex: 502-22)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
386	State Employees		Relocation of 1452 workers from various buildings to a single new building.	Not Reported	In matched multivariate analyses, the reduction in hand/arm symptoms from 1992 to 1993 was associated with improved satisfaction with the physical workstation; the reduction in neck/shoulder/back symptoms was associated with improved chair comfort, fewer housekeeping responsibilities, female gender and low pay range. Longitudinal results suggested that changes in workstations resulted in decreased symptoms.	(Ex. 500-41-100)

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
161	Data Processing Division		<p>In the fall of 1992, the company devised an "action plan," which included hiring a safety and health specialist, allocating funds for the purchase of ergonomically sound furniture, and developing an ergonomics program. The five-step program includes:</p> <ul style="list-style-type: none"> * A safety council comprised of both managers and employees. * Training classes for supervisors and employees. Supervisors are also required to conduct a workstation check every quarter. * Medical-case management requiring the nurse and safety coordinator to evaluate work-related injuries. * Frequent evaluation of new ergonomically safe equipment and technology. * Employee motivation, including monthly ergo activities like videos and exercises. 	<p>Workers' compensation decreased 51% between 1992 and 1994.</p> <p>The division of the company's customer service center responsible for processing credit cards and motor club accounts did not record any lost workdays due to CTDs during the first half of 1994.</p>		<p>CTD News, (5/94, p.3). (Ex: 502-22)</p>

Appendix VI-B. Summary of Case Studies of Ergonomic Programs/Interventions

#	Job Title or Activity	SIC Code	Ergonomic Program/Interventions	Reported Reduction in Injury Rates		Sources
				Lost Workday MSDs	Total MSDs	
121	Data Entry		To address the potentially serious ergonomic stresses in their workplaces, the company implements an informal, yet effective, employee-driven ergonomics program. Although there is an incentive pay system in use, employees are encouraged to pace themselves. There is a formal, written procedure in place encouraging employee input. Ergonomic guidance is prominently displayed in the workplace and accessories such as document holders, adjustable chairs and anti-glare screens are provided and encouraged.	A review of their workers' compensation data for the last four years showed an ergonomic-related claims rate of less than 0.1 per 100 employees.	Not Reported	"Office Ergonomic Solutions: Six Case Studies," Center for Office Technology, (1994, p. 39-41). (Ex: 502-22)
389	Assembly Workers		Incorporated parallel production, team building, multiple skills, and work place redesigns.		No change in task distribution and mechanical exposure variables.	BAO. et al. (1996) (Ex: 38-68)
390	Assembly Workers		Incorporated parallel production, team building and, multiple skills training.	Less satisfaction with psycho social environment.	Diverse physical exposure effects. No effect on MS health.	Johansson et. al. (1993) (Ex: 38-68)

**Appendix VI-C. Summary of Effectiveness Measures
Derived From Case Studies**

Reference No. From Appendix VI-B	SIC	Percent Reduction in Lost Workday Cases	Percent Reduction in Total Cases	Time Period Covered (yrs)
1	20		47.0%	4
308	201	100.0%	71.4%	
197	2011	13.3%		2
198	2011		52.0%	
198	2011	19.0%	32.0%	1
185	2011		17.0%	1
128	2011		60.0%	
5	2011		80.0%	1
230	2011		68.0%	4
329	2011		50.0%	5
2	2011		100.0%	0.5
220	2011		85.0%	5
4	2011		63.0%	4
235	2015	50.0%		2
256	2015	30.1%	32.1%	3
291	2015		46.0%	5
372	2015		67.0%	3
310	2015		80.0%	4
6	2015		100.0%	
8	2015		41.7%	2
7	2015		60.9%	
7	2015		31.8%	
193	2015		92.0%	7
191	2015		80.0%	5
9	2024		100.0%	2
10	2048		100.0%	
11	205		61.8%	3
162	2051		60.0%	3
12	206		100.0%	
240	2086		40.0%	2
190	2092	96.9%		4
221	22		91.7%	7
330	22	24.7%	58.8%	1
140	22		82.6%	3
140	22		94.7%	3
142	2273		50.0%	4
336	23	-15.0%		1
141	23		36.4%	2
388	23		0.0%	
174	23	79.0%		
264	2431		95.5%	
15	2515		88.9%	1
17	252		50.0%	

**Appendix VI-C. Summary of Effectiveness Measures
Derived From Case Studies (Continued)**

Reference No. From Appendix VI-B	SIC	Percent Reduction in Lost Workday Cases	Percent Reduction in Total Cases	Time Period Covered (yrs)
16	252		9.5%	1
168	26	50.0%		3
18	2621		100.0%	0.5
356	2621		43.5%	3
312	2670	70.0%	50.0%	4
20	27		100.0%	2
367	2711	75.0%	84.0%	4
120	2711	100.0%	45.8%	3
326	2711		40.0%	2
232	2732		67.6%	
252	28		82.0%	5
22	283	100.0%	62.0%	10
368	283		100.0%	2
155	283		87.0%	2
153	2834		61.5%	
219	2834		75.0%	1
23	2851	63.0%	40.0%	3
25	2911		90.0%	
352	30		90.0%	
362	3011	66.0%		1
26	3052	100.0%		
147	308	40.0%		1
263	3086	82.4%	85.9%	3
27	31	79.0%		
29	314		57.1%	3
30	314		100.0%	2
31	3149	67.0%	62.0%	2
323	3161	72.7%	87.5%	2
127	3161		83.8%	
32	3199		24.7%	2
33	3229	97.7%		2
34	3231		76.4%	9
35	3253	100.0%		4
241	326	60.0%		
36	3272	100.0%		2
37	33		100.0%	
38	33		83.3%	
306	33	100.0%		
112	3321		60.0%	2

**Appendix VI-C. Summary of Effectiveness Measures
Derived From Case Studies (Continued)**

Reference No. From Appendix VI-B	SIC	Percent Reduction in Lost Workday Cases	Percent Reduction in Total Cases	Time Period Covered (yrs)
348	3341		50.0%	
348	3341		33.0%	
39	3350		50.0%	
40	34		100.0%	
41	34		100.0%	
42	3411		90.0%	
43	3452	80.0%		
44	3496	25.0%		2
45	3499	100.0%		5
151	35	100.0%		4
152	35		27.0%	
171	3511	70.0%		4
47	3523	83.0%		
48	3531		27.0%	
124	357		79.8%	4
370	357		46.9%	
52	3571	100.0%	100.0%	
50	3571		64.3%	2
53	3579		67.0%	2
361	3585	50.0%	90.0%	1.5
55	36		46.0%	1
157	36		28.0%	1
54	36		75.9%	1
56	36		100.0%	
57	36		29.0%	
183	36		100.0%	2
58	3641		100.0%	4
60	3661		76.4%	1
59	3661	80.0%		1.5
62	367		100.0%	
199	3672		46.9%	
213	3678		44.5%	3
66	371	48.0%	11.0%	3
65	371		100.0%	
64	371		93.0%	1
64	371		96.0%	
318	3711		72.1%	9
337	3711		100.0%	
156	3711		40.0%	2
178	3711		40.0%	

**Appendix VI-C. Summary of Effectiveness Measures
Derived From Case Studies (Continued)**

Reference No. From Appendix VI-B	SIC	Percent Reduction in Lost Workday Cases	Percent Reduction in Total Cases	Time Period Covered (yrs)
154	3711		100.0%	3
270	3711	50.0%		
324	3711		26.0%	5
70	3711		100.0%	
72	3711		100.0%	
68	3711		67.5%	3
67	3711	65.0%	48.6%	2
71	3711		100.0%	
73	3714	100.0%		
77	3714	100.0%		
80	3714		100.0%	
81	3714		100.0%	
74	3714		100.0%	
76	3714		67.6%	2
75	3714	100.0%		
78	3714		100.0%	
262	3714		29.0%	
262	3714		78.0%	
79	3714	99.0%		4
184	3714		70.0%	
325	3714		24.0%	5
284	3714		53.0%	0.5
113	3714		50.0%	
313	3714		85.0%	4
158	3716		20.0%	
82	372		96.2%	4
332	3721		25.0%	1
224	3721		33.0%	6
328	3721		44.3%	6
170	3724	91.1%		3
83	3731	100.0%	30.0%	
223	3731	55.0%	30.0%	2
84	3751	33.2%		4
85	3823		100.0%	
179	384		70.2%	
277	380		17.5%	
309	384	100.0%	100.0%	
86	384		75.0%	
87	3841		46.2%	4
88	386		100.0%	3
357	3914		71.4%	
89	3944		100.0%	

**Appendix VI-C. Summary of Effectiveness Measures
Derived From Case Studies (Continued)**

Reference No. From Appendix VI-B	SIC	Percent Reduction in Lost Workday Cases	Percent Reduction in Total Cases	Time Period Covered (yrs)
251	3991		80.0%	1
90	40	100.0%	100.0%	
246	4011	100.0%		
335	4151		33.0%	5
91	42		50.0%	1
92	4213	28.6%	46.2%	2
239	481		33.0%	2
93	481		51.0%	0.5
122	481		33.0%	
258	4911		100.0%	1
94	4911		100.0%	
387	4911		29.0%	
354	4911		25.0%	
282	495		73.6%	7
96	5137		91.7%	
97	514		42.9%	2
248	514		72.4%	0.75
207	5211	100.0%		2
131	53		60.0%	5
247	5311		50.0%	3
351	5411		44.7%	1
364	5411		76.2%	4
98	5812		40.0%	
99	5932		56.5%	2
177	60	50.0%		3
100	6021		70.4%	
355	63		90.0%	1
353	80	91.7%		
218	805		67.0%	
216	805	80.0%		2
176	805		16.3%	3
217	805		50.0%	2
209	805	71.1%	85.9%	3
295	805		75.0%	0.5
175	805	80.0%		2
166	805		40.0%	3
215	805		75.0%	2
294	805		73.8%	
294	805		60.0%	
300	805		23.0%	
214	805		50.0%	2

**Appendix VI-C. Summary of Effectiveness Measures
Derived From Case Studies (Continued)**

Reference No. From Appendix VI-B	SIC	Percent Reduction in Lost Workday Cases	Percent Reduction in Total Cases	Time Period Covered (yrs)
211	805	35.0%	43.0%	1
305	805		50.0%	
196	805	96.6%	75.0%	2
146	805	50.0%		1
145	805		50.0%	
227	805	67.0%		1
101	805		43.4%	
243	805	33.0%		1
194	805	50.0%		3
138	805	50.0%		1
236	805	75.0%		2
316	805	100.0%		1
136	805		80.0%	2
117	805		90.0%	0.5
296	805		74.0%	3
237	805		67.0%	2
129	805	80.0%		
126	805	54.0%	50.0%	1
125	805	50.0%		1
195	805		50.0%	2
359	805	75.0%	77.8%	2
363	805	50.0%	50.0%	2
375	805		68.0%	2
360	805		71.4%	2
338	805		74.0%	3
343	805	75.0%		
374	805		91.7%	1
366	805	40.0%	40.0%	2
344	805		0.0%	1
315	806		62.5%	
298	806		83.0%	
298	806		75.0%	
292	806	74.0%	50.0%	2
340	806		80.0%	
341	806		95.0%	
304	806		40.0%	1.5
317	806	93.8%		
382	806	44.1%		4
255	806		80.0%	6
103	8062		94.0%	1

**Appendix VI-C. Summary of Effectiveness Measures
Derived From Case Studies (Continued)**

Reference No. From Appendix VI-B	SIC	Percent Reduction in Lost Workday Cases	Percent Reduction in Total Cases	Time Period Covered (yrs)
104	8062		39.0%	4
104	8062		71.0%	2
385	8062	83.7%		2
106	8062		83.3%	
107	8062		94.0%	
108	8062	35.0%	43.0%	
105	8062		25.0%	1.5
346	8062	89.9%	55.0%	
167	82	95.0%		3
342	8733		23.0%	
119	91		57.3%	1
119	91		25.9%	1
109	91		18.5%	1
349			100.0%	2.5
349			-5.8%	2.5
349			28.9%	2.5
349			42.9%	2.5
349			100.0%	2.5
274			50.0%	
204			100.0%	4
373			69.2%	2
311			100.0%	4
212			60.0%	9
115			100.0%	1
254			54.7%	2
267			33.0%	
159			46.0%	0.75
159			78.6%	0.75
161		100.0%		0.5
389			0.0%	
390			0.0%	

VII. Significance of Risk

In this section of the preamble, OSHA conducts several analyses and presents data and information to demonstrate, first, that musculoskeletal disorders (MSDs) constitute material harm under the Occupational Safety and Health Act (OSH Act or Act). This discussion demonstrates that MSDs are painful, often disabling injuries and illnesses that cause lost work time, require medical treatment, involve restricted work, and, all too often, result in surgical interventions.

The Agency then demonstrates the significance of the risk of incurring this material harm in the industries and occupations covered by the scope of the ergonomics standard. As OSHA's analysis shows, over a working lifetime, workers in jobs that meet the final rule's exposure screen face risks ranging roughly from 33 cases per 1,000 workers to 926 cases per 1,000 workers, risks that are clearly significant by any reasonable measure. Even on an annual rather than lifetime basis, many of the workers who would be covered by the standard are at great risk: nursing aides and truck drivers, for example, can expect to suffer between 32 and 42 lost-workday musculoskeletal disorders for every 1,000 workers in every year that they work. Again, that risks of this magnitude are significant within the meaning of the Act is not disputable.

Parts A and B below thus demonstrate unequivocally that the first two tests OSHA must meet before it can regulate—that the hazard regulated by the standard constitutes material harm and that the risk posed to workers covered by the standard is significant, as that term has been defined in OSHA case law—have been met. OSHA's response to comments received on its significance of risk analysis in the proposed rule appear in Part C.

A. Material Harm

The OSH Act requires OSHA to make a threshold finding that a significant risk of material harm exists in the workplace before issuing an occupational safety or health standard. See *Benzene*, 448 U.S. 607, 642; 58 FR 16612, 16614 (Mar. 30, 1993). What constitutes "material harm" in any particular case is, at bottom, a policy determination, for "OSHA is not required to state with scientific certainty or precision the exact point at which each type of [harm] becomes [material]." See *AFL-CIO v. OSHA (PELs)*, 965 F.2d 962 (11th Cir. 1992). As long as its determination is reasonable, OSHA is entitled to deference; however, OSHA must be cognizant of all forms and

degrees of material harm—not just death or serious physical harm—and may act with a "pronounced bias towards worker safety." *Building & Constr. Trades Dep't., AFL-CIO v. Brock*, 838 F.2d 1258, 1266 (D.C. Cir. 1988).

Injuries or illnesses that affect a worker's job performance, result in lost workdays or restricted work, and/or result in medical treatment beyond first aid constitute material harm under the OSH Act. See PELs, 965 F.2d at 974–75. This was confirmed by the 11th Circuit Court of Appeals in its review of OSHA's Air Contaminants Standard. In the Air Contaminants standard, OSHA set permissible exposure limits for over 400 substances to prevent the onset of certain health effects, including sensory irritation (i.e., stinging, itching, and burning of the eyes, tearing (or lacrimation), a burning sensation in the nasal passages, rhinitis (nasal inflammation), cough, sputum production, chest pain, wheezing, and dyspnea). *Id.* OSHA found that in certain circumstances these effects were fleeting; however, substantial evidence in the rulemaking record suggested that these effects could be quite serious at times and could affect a person's ability to perform at work:

"OSHA concludes that exposure limits are needed for those substances for which PELs are being established in this rulemaking to protect against sensory irritant effects that result in objective signs of irritation, such as coughing, wheezing, conjunctivitis, and tearing. Such levels of mucous membrane irritation may require medical treatment, adversely affect the well-being of employees, and place the affected individuals at risk from increased absorption of the substance and decreased resistance to infection. Exposing workers repeatedly to irritants at levels that cause subjective irritant effects may cause workers to become inured to the irritant warning properties of these substances and thus increase the risk of overexposure." 54 FR 2444–45 (Jan. 19, 1989).

Industry representatives challenged OSHA's determination that these health effects constituted "material impairment" within the meaning of section 6(b)(5) of the OSH Act. *Id.* While OSHA conceded that minor irritation would not, by itself, constitute "material impairment," it concluded that sensory irritation that resulted in medical treatment or affected job performance would constitute such impairment. PELs, 965 F.2d at 974. The court agreed with this finding:

"We interpret this explanation as indicating that OSHA finds that although minor irritation may not be a material impairment, there is a level at which such irritation becomes so severe that *employee health and job performance* are seriously

threatened, even though those effects may be transitory. * * * Overall, we find that OSHA's determinations of what constitute 'material impairments' are adequately explained and supported in the record." *Id.* at 975 (emphasis added).

The OSH Act also permits OSHA to regulate a hazard to prevent the signs or symptoms of an injury or illness from becoming more severe and disabling. See *Lead*, 647 F.2d at 1252 ("We conclude that if OSHA could find on the basis of substantial evidence that preventing subclinical effects of lead disease would help prevent the true clinical phase of lead disease, the statute empowered it to set a blood-lead level goal to prevent these effects."). The OSH Act does not require OSHA to wait until an injury or illness becomes so severe that employees become disabled before it has authority to regulate. Such an approach would turn the OSH Act from a statute designed to prevent injuries and illnesses from occurring to one that reacts to injuries and illnesses that have already occurred. This was not Congress' intent when it tasked OSHA with "assuring as far as possible every working man and woman in the Nation safe and healthful working conditions." 29 U.S.C. 651(2)(b).

Based on the evidence discussed in this and other sections of the preamble, as well as all other evidence gathered by OSHA and placed in the public docket of this rulemaking, OSHA has concluded that MSDs as defined by this standard constitute material harm under the OSH Act. OSHA recognizes that these disorders are not life-threatening and that some of these disorders may be reversible, particularly if early intervention is provided. Nonetheless, evidence in the record shows that these disorders are debilitating (*Brisson et al.* 1989, Ex. 26–47; *Vingard et al.* 1991, Ex. 26–44; *Berg et al.* 1988, Ex. 26–46; *Liss et al.* 1992, Ex. 26–55; *Webster and Snook* 1994, Ex. 26–33; *Binder and Hazleman* 1983, Ex. 26–45; *Boshuizen et al.* 1990, Ex. 26–40; *Blanc et al.* 1996, Ex. 26–42; *Liberty Mutual Research Center for Safety and Health*, 1998, Ex. 26–54). These disorders cause persistent and severe pain, lost worktime, reduction or loss of the worker's normal functional capacity both in work tasks and in other of life's major activities, loss of productivity, and significant medical expenses. Where preventive action or early medical intervention is not provided, these disorders can result in permanent damage to musculoskeletal tissues, causing such disabilities as the inability to use one's hands to perform even the minimal

tasks of daily life (e.g., lifting a child), permanent scarring, and arthritis.

Furthermore, OSHA is triggering obligations on employers to respond to reports of MSDs only when such reports reach the level of severity sanctioned by the OSHA Act. Contrary to the allegations of some commenters, see e.g., Ex. 30–3865; 500–187, this standard does not trigger employer obligations based solely upon employee reports of “aches and pains.” An employer is only required to respond to an employee report of an MSD when it: (1) Results in one or more lost workdays, one or more days of restricted work, medical treatment beyond first aid, or (2) includes signs or symptoms of an MSD that persist for 7 or more consecutive days, and (3) the employer is exposed to risk factors at the levels described in the Basic Screening Tool, which are associated with increased risk. MSDs that result in days away from work, restricted duty, or medical treatment beyond first aid clearly constitute material harm under the OSH Act, as described above. See PELs, 965 F.2d at 974–75. Moreover, it is clear that OSHA may trigger employer action upon employee reports of signs or symptoms of MSDs that persist for seven or more consecutive days. There is substantial evidence in the rulemaking record that persistent signs or symptoms of MSDs will progress and become more severe and disabling if they are not treated and the employee remains in the job unabated. See (Tr. 7660, 7884, see also (Ex. 32–450–1). OSHA need not wait for signs and symptoms of MSDs to become disabling to act; rather, OSHA may “act to ‘reduce the risk’ of serious material impairment [at some point in the future].” See Lead, 647 F.2d at 1253.

The pain associated with these workers is not the normal muscle soreness associated with job break-in or conditioning, or temporary muscle strain due to doing new or unusual tasks. Instead, the pain is severe and persistent. Many employees must be placed on medication to alleviate or at least reduce the intensity of their pain. The pain of MSDs may also continue or may even manifest after the employee is removed from exposure at the end of the workshift (Ex. 26–1263). In addition, the pain usually increases if exposure to the ergonomic risk factors continues (Ex. 26–1263). OSHA believes that this type of severe and persistent pain, and the tissue damage underlying this pain, clearly constitutes material harm under the OSH Act.

The Chamber of Commerce argued that OSHA should not rely on the testimony of injured workers to

demonstrate that exposure to the risk factors at issue causes a significant risk of material harm because this testimony: (1) Includes MSDs that are not included in the rule; (2) contradicts trained physicians’ findings; and (3) gives no consideration to potentially confounding factors. Ex. 500–188. But OSHA is not relying on this testimony to demonstrate that work causes MSDs or that this particular standard will reduce the incidence of MSDs, as the Chamber incorrectly suggested. Other evidence and data (described above) in the rulemaking record demonstrates this. The testimony of injured workers, however, is particularly probative in demonstrating how MSDs significantly affect peoples’ lives. For this, statistics, epidemiological data, and other evidence are not alone sufficient. The testimony of these workers puts a human face on the pain and suffering experienced everyday by workers who suffer from these injuries. It also convincingly demonstrates that MSDs are not everyday “aches and pains” experienced by all, but serious, disabling conditions.

MSDs of most kinds are also recognized as compensable under virtually all State workers’ compensation plans, and these disorders imposed nearly \$20 billion in medical costs and industry payments on the U.S. economy in 1994 (see the Economic Analysis section of this preamble). Under workers’ compensation, however, employees are reimbursed only where their work-related injury or disorder requires medical treatment and/or results in lost workdays. Moreover, payments for lost wages are not provided unless the employee’s injury or disorder results in a certain number of lost workdays (the number varies across the States and ranges from one to seven days). According to evidence presented in the Economic Analysis, a significant number of musculoskeletal disorder workers’ compensation claims result in lost workdays. For example, according to a study by Webster and Snook (1994, Ex. 26–33) based on workers’ compensation data from Liberty Mutual Insurance Company, the largest underwriter of workers’ compensation insurance in the country, more than 45 percent of all low back pain cases involved indemnity payments for lost workdays. This study also indicated that, on average, more than 65 percent of the workers’ compensation costs for musculoskeletal disorders represented indemnity payments for lost workdays. Overall, work-related low back pain accounts for 15 percent of all Liberty

Mutual workers’ compensation claims and 23 percent of their costs (Liberty Mutual Research Center for Safety and Health, 1998, Ex. 26–54).

Further evidence of the disabling nature of MSDs comes from the Bureau of Labor Statistics (BLS) data for 1996, which show that the median number of lost workdays (LWD) per recordable lost-time MSD is higher than the median across all lost workday injuries (see Figure VII–1). For example, the median number of lost workdays for cases classified by BLS as carpal tunnel syndrome, tendinitis or tenosynovitis, or musculoskeletal and connective tissue disorders, is 25, 9, and 10 days, respectively. More than one-half of all carpal tunnel LWD cases and one-third of musculoskeletal and connective tissue disorder LWD cases result in more than 20 lost workdays, compared to less than one-fourth of all LWD injuries. Among workers who received compensation awards in 1994 for upper-extremity disorders, the average length of disability was 87 days, with 6.8 percent of the claims covering one-year or more of disability (Liberty Mutual Research Center for Safety and Health, 1998, Ex. 26–54).

Finally, several individual studies provide additional evidence demonstrating the disabling nature of MSDs. A study of female sewing machine operators showed an increased prevalence of disability among both retired and active workers compared to national rates of disability (Brisson *et al.*, 1989, Ex. 26–47). Operators who had left their jobs had a greater rate of severe disability when compared to workers who had left other types of employment. Vingard *et al.* (1991, Ex. 26–44) found an increased risk of early retirement among workers exposed to heavy or medium work loads due to disorders of the lower back, neck/shoulder, hip, or knee. An elevated incidence of long-term absenteeism and disability due to intervertebral disc disorders was found among tractor drivers, with the incidence appearing to increase with whole-body vibration dose and duration (Boshuizen *et al.* 1990, Ex. 26–40). An analysis of data from the National Health Interview Survey showed that repetitive bending of the hand or wrist on the job was significantly associated with the frequency of self-reported carpal tunnel syndrome (CTS), and that work-related disability was common among the 544 subjects reporting CTS. The persistence of symptoms associated with MSDs is illustrated by two other studies. Berg *et al.* (1988, Ex. 26–46) studied the prevalence of MSD symptoms among 327 retired shipyard workers who had been engaged in heavy

physical work and found that the prevalence of symptoms remained unchanged over a three-year period. In another study, Binder and Hazleman (1983, Ex. 26–45) followed the health status of 125 patients with lateral epicondylitis over a 1- to 5-year period after initial presentation of the disorder. Over the follow-up period, 40 percent of the patients continued to have discomfort that affected some daily activities.

OSHA has promulgated standards where the adverse health effects associated with exposure to substances or conditions are serious but not necessarily life-threatening, such as health effects that interfere with normal daily life or job performance, or that require substantial medical intervention. See Cotton Dust (29 CFR 1910.1046), Occupational Noise Exposure (29 CFR 1910.95), Occupational Exposure to Lead (29 CFR 1910.1025), Occupational Exposure to Formaldehyde (29 CFR 1910.1048). For example, in promulgating the Hearing Conservation Amendment, OSHA determined that “* * * material impairment of hearing is directly related to people’s ability to understand speech as it is spoken in everyday social conditions * * *.” (46 FR 46236), including being able to understand speech in noisy environments. In the Formaldehyde standard, OSHA based its permissible exposure limit (PEL) and ancillary provisions, in part, on evidence that employees were at significant risk of developing sensory irritation (e.g., burning and tearing of the eyes, severe irritation of the nose and throat) and skin diseases at the existing PEL, and that these effects were sufficiently severe to interfere with the employee’s ability to perform job functions (52 FR 46168, 46234–37).

This standard is similar to these other OSHA standards in this respect. MSDs also result in material harm by causing temporary or permanent physical damage to the body. Such damage can include severe inflammation of joints and tissues; reduced conduction velocity in peripheral nerves; partial or total loss of strength in an extremity; tearing of muscles and tendons; numbness; decreased range of motion; arthritis; and pain. When this damage occurs, employees are unable to perform their jobs at all or at normal performance levels without experiencing pain or causing further damage. Accordingly, OSHA concludes that MSDs as defined by this standard constitute material harm under the OSH Act.

B. Significant Risk

As stated above, a plurality of the Supreme Court in *Benzene* held that the OSH Act requires a threshold finding that a significant risk of material harm exists and that the standard being promulgated will substantially reduce that risk. See *Benzene*, 448 U.S. 607, 642; see also 58 FR 16612, 16614 (Mar. 30, 1993). In so holding, the plurality noted that “precise quantification of risks is * * * impossible” given the imperfect state of scientific knowledge. *Benzene*, 448 U.S. at 652. Thus, while “it is OSHA’s responsibility to determine, in the first instance, what it considers to be a “significant” risk, * * * the requirement that a “significant” risk be identified is not a mathematical straitjacket * * * [and] the Agency has no duty to calculate the exact probability of harm.” *Id.* at 655. Indeed, “there are a number of ways in which the Agency can make a rational judgment about the relative significance of the risks associated with exposure * * *,” *id.* at 656–57, and “so long as they are supported by a body of reputable scientific thought, the Agency is free to use conservative assumptions in interpreting the data * * *, risking error on the side of overprotection rather than underprotection.” *Id.* at 656.

Since *Benzene*, OSHA has adopted a variety of methods for determining what constitutes a significant risk. See e.g., *Asarco, Inc. v. OSHA*, 746 F.2d 483, 490–95 (9th Cir. 1984); *Public Citizen Health Research Group v. Tyson*, 796 F.2d 1479 (D.C. Cir. 1986). With respect to section 6(b)(5) standards, OSHA has often utilized scientifically-based mathematical modeling techniques to determine risk at certain levels of exposure. This modeling permits OSHA to “extrapolate [risk] * * * into areas where experimental [or observational] data do not exist.” *Public Citizen*, 796 F.2d at 1496. With respect to non-section 6(b)(5) standards, however, OSHA has not needed to engage in quantitative modeling techniques to determine significant risk because it typically has observational data that quantifies the risk faced by workers to particular hazards. In the Electric Power Generation rulemaking, for example, OSHA found that the generation, transmission, and distribution of electric power and the non-use or misuse of appropriate electrical protective equipment resulted in 86 fatalities and 12,977 injuries annually and that the standard would prevent 61 fatalities and 1,634 injuries annually. Thus, the OSH Act does not require OSHA to construct dose-response relationships or other models for every

hazard before it can regulate. OSHA has considerable leeway to choose a form of analysis appropriate to the available evidence and need not attempt to fit the evidence to a preselected analytical method.

There is no need, in the case of musculoskeletal disorders, for OSHA to engage in risk modeling, low-dose extrapolation, or other techniques of projecting theoretical risk to identify the magnitude of the risk confronting workers exposed to ergonomic risk factors. The evidence of significant risk is apparent in the annual toll reported by the Bureau of Labor Statistics, the vast amount of medical and indemnity payments being made to injured workers and others every year (nearly \$20 billion in direct costs and as much as \$60 billion more in indirect costs), and the lost production to the U.S. economy imposed by these disorders. Similarly, there is no need for OSHA to turn to complex theoretical projections of reductions in risk to demonstrate that the standard will substantially reduce this significant risk. Ergonomics programs work in practice. The evidence is there in the form of hundreds of epidemiological analyses, meta-analyses, and case studies reporting the effectiveness of ergonomic programs in reducing risk. The following discussion, and the analyses presented below, demonstrate the significance of the risk confronting workers in the industries and occupations targeted in the standard and make the case for the standard’s effectiveness.

In this rulemaking there are, as mentioned above, extensive data on the adverse effects on the human musculoskeletal system of exposure to workplace risk factors such as repetitive motions; awkward postures; and the use of excessive force. As described in the Health Effects and Quantitative Risk Assessment sections of this preamble, studies and national statistics are available to demonstrate the high incidence and prevalence of work-related musculoskeletal disorders occurring or existing among workers exposed to ergonomic risk factors. Estimates of the risk of harm confronting exposed workers can be based directly on the rates of work-related musculoskeletal disorders currently being reported, and BLS survey data can be used to demonstrate the degree to which work-related musculoskeletal disorders have occurred across nearly all major industrial sectors and in numerous occupations.

The data discussed in the Quantitative Risk Assessment and

Health Effects sections of the preamble demonstrate that the risk of work-related musculoskeletal disorders constitutes a significant risk under the OSH Act. For example, OSHA estimates, based on the 1996 BLS data, that more than 590,998 lost-workday (LWD) musculoskeletal disorders occurred among workers in industries that are within the scope of the final rule, and that were recorded and reported by employers in 1996 (see Table VI-8 of the Risk Assessment). The estimated annual incidence of employer-reported MSDs (both upper-and lower-bound estimates), defined as the number of MSDs occurring in a given year per 1,000 workers employed in jobs that meet the final rule's exposure screen in each industry sector exceeded 1 LWD case per 1,000 workers for all but 3 of the 2-digit SIC general industry groups in 1996; the incidence exceeded 10 LWD cases per 1,000 workers in 15 of these industry sectors (see Table VI-5 in the Quantitative Risk Assessment section of the preamble). Further, OSHA estimates that the annual incidence of employer-reported LWD MSDs reached 1 case or more per 1,000 workers for 79 percent of all of the occupational groups for which BLS estimated the numbers of MSDs and employees. For 36 of these occupations, the estimated annual incidence of LWD MSDs exceeded 10 cases per 1,000 workers (Table VI-6 in the final Risk Assessment). For some high risk occupations, such as practical nurses, nursing aides and attendants, laborers, public transportation attendants, and truck drivers, annual incidence rates are on the order of 32 to 42 LWD MSD cases per 1,000 workers per year. These extremely high incidence rates, however, are underestimates of the true incidence of MSDs, because they are based only on lost workday cases. OSHA estimates that the number of MSDs that do not result in lost workdays is about twice that of LWD MSDs.

In the final Risk Assessment, OSHA also estimated the probability that an employee will suffer at least one musculoskeletal disorder due to workplace risk factors over a 45-year working lifetime as both an upper-and lower-bound estimate. The upper-bound estimate represents the lifetime risk to an employee who works in job that meets the final rule's exposure screen, and assumes that all of the risk is attributable to his or her workplace exposure to physical risk factors. The lower-bound estimate represents the lifetime risk to an employee in a job that meets the screen, but assumes that only

part of that risk is attributable to exposure (*i.e.*, the rest of the risk is background). The results are presented by 2-digit SIC industry group in Table VI-9 of the Risk Assessment. The probability of experiencing at least one LWD MSD during a working lifetime ranges from 33 per 1,000 workers (lower-bound estimate in SIC 62, Security and Commodity Brokers, Dealers, Exchanges, and Services) to 926 per 1,000 workers (upper-bound estimate in SIC 45, Air Transportation). The expected number of MSDs that will occur in a cohort of workers all entering an industry at the same time and working for 45 years ranges from 34 per 1,000 workers to 2,530 per 1,000, depending on the industry sector, since it is possible for a worker to experience more than one MSD in a working lifetime.

The estimates of lifetime risk presented above are based on an assumption that workers in jobs that meet the final rule's screen are at three-fold higher risk than are workers in jobs that do not meet the screen. As explained in the final Risk Assessment, this assumption is well-supported by the data base of almost 200 epidemiological studies reviewed by the Agency and found to be of acceptable quality (see Section V, Health Effects). However, this assumption is not critical to the Agency's determination that the risks to workers exposed to biomechanical risk factors at the level of the final rule's screen are highly significant. In its final risk assessment, OSHA presented another analysis that is identical to that presented as part of the proposed rule. That analysis relies on BLS-provided estimates of the incidence of MSDs that is calculated across the entire working population; that is, the BLS-provided incidence figures do not recognize any difference in incidence of MSDs that occur between higher-risk and lower-risk workers. Even under that assumption, which minimizes the estimate of the risk to highly exposed workers, OSHA's estimates of lifetime risk are unambiguously significant. Estimates of the probability of experiencing at least one MSD over 45 years range from 24 to 813 per 1,000 workers, and the average number of MSDs predicted to occur over 45 years ranges from 24 to 1,646 per 1,000 workers (see Table VI-7 in the final Risk Assessment).

Although these data indicate that the risk of experiencing an MSD is clearly significant, OSHA believes that these data seriously understate the true risk. First, the BLS data capture only those

MSD injuries reported by employers as lost workday injuries. MSDs that force an employee to be temporarily assigned to alternate duty, as well as those work-related MSDs not reported to employers by employees or not recorded by employers, are not included in these risk estimates.

Evidence of Underreporting

There is also evidence that the actual risks attributable to occupational exposure to ergonomic risk factors may be much higher than is indicated by the BLS statistics. Many peer-reviewed studies have been published in the scientific literature in the last 18 years that document the underreporting of MSDs on OSHA Logs (McCurdy *et al.*, 1999, Ex. 2-2; Silverstein *et al.*, 1997, Ex. 26-28; Pransky *et al.*, 1999, Ex. 26-922; Park *et al.*, 1992, Ex. 26-1259; Park *et al.*, 1996, Ex. 26-1261; Nelson *et al.*, 1992, Ex. 26-1260). Table VII-1 summarizes these studies. These studies document extensive and widespread underreporting on the OSHA Log of occupational injuries and illnesses in general (McCurdy *et al.*, 1999, Ex. 2-2) and of MSDs in particular (Silverstein *et al.*, 1997, Ex. 26-28; Fine *et al.*, 1986, Ex. 26-920; Pransky *et al.*, 1999, Ex. 26-922; Park *et al.*, 1992, Ex. 26-1259; Park *et al.*, 1996, Ex. 26-1261; Nelson *et al.*, 1992, Ex. 26-1260). Underreporting on the Log is directly related to OSHA's significant risk finding, because incidents that are not reported on the Log but should have been would downwardly bias the BLS annual survey numbers on which OSHA's risk estimates depend.

Since OSHA published the proposed rule, several commenters have provided additional information and comment, either through the submission of written comments and additional studies on underreporting to the docket, or through testimony at the hearing. NIOSH provided seven health hazard evaluations (HETAs), as described in the NIOSH pre-hearing comments (Ex. 32-450-1), that document extensive and widespread underreporting on the OSHA Log of occupational injuries and illnesses (NIOSH HETA# 88-344-2092, 1991 (Ex. 32-450-1); NIOSH HETA# 90-273-2130, 1991 (Ex. 32-450-1-13); NIOSH HETA# 92-331, 1993 (Ex. 32-450-1); NIOSH HETA# 95-0294-2594, 1996 (Ex. 32-450-1-22); NIOSH HETA# 97-0276-2724, 1999 (Ex. 32-450-1-2); NIOSH HETA# 96-0101-2476, 1997 (Ex. 32-450-1-26); NIOSH HETA# 98-0085-2715, 1998 (Ex. 32-450-1-10). These new studies have been incorporated into Table VII-1.

TABLE VII-I.—SUMMARY OF UNDERREPORTING STUDIES

Study	Measure of underreporting	Extent of underreporting observed	Additional detail
McCurdy, Schenker, and Samuels, <i>Am. J. Public Health.</i> 81:85 (1991) Ex. 2–2.	Percentage of cases meeting OSHA reporting criteria not recorded on OSHA Log.	40% of all reportable cases not recorded; for illnesses, 56% not recorded.	10 manufacturing facilities in 6 states from semiconductor industry with approx. 50,000 employees; 24% cases met OSHA recording criteria.
NIOSH. Health Hazard Evaluation Report, HETA 93–0233–2498, (1995) Ex. 26–1255.	Failure to report lost workdays and restricted work on OSHA 200 Log.	Not quantified; “several” employees had surgeries for WMSDs in 5-year period and 1/3 of employee were on restricted work, but no LWDIs reported on Log over 5-year period.	Winding and taping department of an instrument transformer manufacturer; 27 employees in department.
NIOSH. Health Hazard Evaluation Report, HETA 93–0860–2438, (1994) Ex. 26–1256.	Percent of medically confirmed WMSD cases not recorded on OSHA Log or not reported to employer.	5 employees reported to NIOSH that they had been diagnoses with carpal tunnel syndrome (CTS); of these, 2 did not report their illness to the employer. 1 of the 5 reported cases were not reported on log.	News department of large metropolitan TV-news station; video tape editor and other employees.
Silverstein, Stetson, Keyserling, and Fine <i>Am. J. Ind. Med.</i> 31:600 (1997) Ex. 26–28.	Incidence (per 100 workers years) of work-related MSDs, reported on OSHA 200 logs compared with cases that received medical treatment, as identified by self-administered questionnaire.	Plant/year; OSHA 200 Log; Self-report: Plant 1: 1986: 1.0; 30.9 1987; 2.7; 1988; 6.9; Plant 2: 1986: 0.9; 40.9 1987; 11.9 1988; 21.4. Plant 3: 1986: 20.3; 47.8 1987; 14.6 1988; 19.43. Plant 4: 1986: 0.7; 24.5 1987; 2.1 1988; 9.9..	Four automobile manufacturing plants. 713 out of 948 workers selected for the study completed the questionnaire.
Fine, Silverstein, Armstrong, Anderson, and Sugano, <i>JOM.</i> 28:674 (1986) Ex. 26–920.	Incidence (per 100 worker-years) of upper-extremity MSDs reported on OSHA 200 logs compared with workers' compensation (WC), medical absence records (MAR) and medical case records (MCR).	Plant; 200; OSHA WC, MAR, MCR: B: 0.03; 0.29; 3.04; 2.03 C: 0.15; 0.45; 1.85; 13.98	Data from two large automobile manufacturing plants (total employment not reported).
Pransky, Snyder, Dembe, and Himmelstein, <i>Ergonomics.</i> 42:171 (1999) Ex. 26–922.	Percent of workers reporting musculoskeletal symptoms caused or aggravated by work, compared to OSHA Log entries.	Work-related Symptom; % reporting; % on Log.. Hand/Wrist; 86%; 6% Arm; 33%; 1% Neck; 21%; 0 Back/legs; 28%; 2% 9% of workers reported that symptoms resulted in lost work days over the past year. 6% reported they were formally assigned light-duty work by plant nurse. 15% reported symptoms resulted in information light-duty work arranged by co-workers..	Questionnaire administered to 110 packers, of whom 98 responded. Plant produces variety of childrens' products.
Park, Krebs, and Mirer <i>JOEM.</i> 38:1111 (1996) Ex. 26–1261.	Number of claims made in a sickness and accident (S&A) disability (sick leave) system compared to lost-work-day (LWD) injuries and illnesses recorded in OSHA log.	Only 7 of an estimated 47 (15%) S&A upper extremity LWD cases in 1992 were recorded on the OSHA Log. For LWD back injuries, 27 of an estimated 36 (75%) S&A cases were recorded.	Study of an automotive assembly and stamping complex employing 10,000 workers.

TABLE VII-I.—SUMMARY OF UNDERREPORTING STUDIES—Continued

Study	Measure of underreporting	Extent of underreporting observed	Additional detail
Park, Nelson, Silverstein, and Mirer, <i>JOM</i> . 34:731. (1992) Ex. 26–1259.	Medical insurance claims linked to work histories compared to OSHA logs.	From 1984 to 1987, OSHA logs failed to record between 20 and 80 percent of occupational MSDs..	Conclusion based on authors' own unpublished data from insurance records of five automotive manufacturing plants. These records identified 11,577 MSD health claims made by 3,204 workers.
Nelson, Park, Silverstein, and Mirer, <i>Am. J. Public Health</i> . 82:1550 (1992) Ex. 26–1260.	Medical insurance claims linked to work histories compared to OSHA logs..	From 1985 through 1986, OSHA logs identified 59 hand/wrist MSD cases compared to 150 cases identified in health insurance records. For all MSDs from 1984 through 1987, only 9% of cases identified through insurance claims were recorded on OSHA logs (the authors cite data from Parks <i>et al.</i> (1992) indicating that about half of the upper extremity MSD cases from insurance claims are attributable to work.	
NIOSH Health Hazard Evaluation Report, HETA 88–344–2092 (1991) Ex. 32–450–1.	Percentage of workers with work-related (W–R) upper extremity (UE) MSDs not seeking medical care. W–R UE MSD cases defined by NIOSH standardized symptom questionnaires and positive physical findings from physician-conducted physical examinations.	40% of supermarket checkers with WR UE MSD did not seek medical care.	W–R MSD's not brought to the attention of a health care professional (HSP) will not be recorded on the OSHA 200 logs.
NIOSH Health Hazard Evaluation Report, HETA 90–273–2130 (1991) Ex. 32–450–1–13.	Percentage of workers with W–R UE MSD not seeking medical care and whether they were recorded on the OSHA 200 logs. W–R UE MSD defined by NIOSH standardized symptom questionnaires.	85% of employees with W–R UE MSD symptoms were not evaluated by a HSP. A small fraction of those with W–R UE MSD were recorded on the OSHA logs.	Jewelry manufacturing employees exposed to repetitive, forceful, and awkward postures during job tasks (MSD hazards).
NIOSH Health Hazard Evaluation Report, HETA 92–331 (close-out letter) (1993) Ex. 32–450–1.	Evaluation to determine compliance with OSHA corporate settlement agreement. Review of plant's health clinic algorithm to evaluate and treat symptomatic workers.	Large numbers of symptomatic workers evaluated by HAPS and prescribed a temporary job transfer. HSP deemed these as "preventive" job transfers and did not record these on the OSHA 200 logs.	Red meatpacking plant employees exposed to MSD hazards. BLS requires cases involving employees with W–R symptoms assigned a job transfer to be record onto the logs.
NIOSH Health Hazard Evaluation Report, HETA 95–0294–2594 (1996) Ex. 32–450–1–22.	Percentage of workers with W–R UE MSD not seeking medical care and whether they wer recorded on the OSHA 200 logs. W–R UE MSD defined by NIOSH standardized symptom questionnaires.	75% of employees with W–R UE MSD did not seek medical care. A small fraction of those with W–R UE MSD were recorded onto the OSHA 200 logs.	Research technicians conducting pipetting operations with MSD hazards.
NIOSH Health Hazard Evaluation Report, HETA 96–0101–2476 (1997) Ex. 32–450–1–26.	Employee health records and employee interviews compared with the plant's OSHA 200 logs. Same method used to determined the accuracy of the number of lost and restricted workdays recorded.	23% of employees with W–R UE MSD not recorded onto the OSHA 200 logs. The number of actual lost or restricted work days significantly under-reported.	Truck frame assumably employees exposed to MSD hazards. Under-reporting the lost or restricted workdays gives the impression of a less serious disorder.
NIOSH Health Hazard Evaluation Report, HETA 97–0276–2724 (1999) Ex. 32–450–1–2.	Clinic employee report of injury illness forms compared with the plant's OSHA 200 logs. Employee health records compared with the plant's OSHA 200 logs..	Many entries listed on the Clinic Employee Report of Injury/Illness forms and many cases from individual employee health records were not recorded on the OSHA 200 logs.	Fiberglass manufacturing plant employees exposed to MSD hazards.
NIOSH Health Hazard Evaluation Report, HETA 98–0085–2715 (1998) Ex. 32–450–1–10.	Comparison of workers reporting MS symptoms on a body map diagram with the OSHA 200 logs.	Several discrepancies between these two lists. Employees probably not reporting all W–R symptoms to employer.	Casket manufacturing employees exposed to MSD hazards.

As stated by NIOSH (Ex. 32-450-1), these HETAs compared the OSHA 200 Logs with work-related MSDs ascertained via the following mechanisms: (1) Confidential medical interviews; (2) review of employee medical records of private health care providers; (3) health surveys utilizing standardized MSD symptom questionnaires; and (4) health surveys defining cases as those with work-related symptoms and positive physical findings conducted by physicians performing physical examinations targeted to the musculoskeletal systems. In one HETA, NIOSH estimated the extent of the underreporting of recordable cases of MSDs on OSHA Logs as 23 percent of cases among a group of truck frame workers (Ex. 32-450-1-26). In other studies, NIOSH quantitatively characterized the extent of the underreporting in these HETAs as ranging from "a small fraction" for jewelry workers and research technicians to "many not reported" for fiberglass manufacturers to "large numbers not reported" for red meatpacking plants; for a group of supermarket checkers, NIOSH quantitatively estimated that the underreporting amounted to 40% of all cases. NIOSH states that there is no reason to believe that these HHEs are not representative of the widespread underreporting believed to be associated with work-related MSDs. NIOSH suggested that OSHA include these HETAs in the final standard, to strengthen the evidence of MSD underreporting.

The rulemaking record thus contains convincing evidence that MSDs are often underreported; this evidence includes the new peer-reviewed studies submitted by several rulemaking participants. OSHA finds this evidence persuasive and has incorporated this information into this final standard, as appropriate.

Some commenters agreed that OSHA was correct in its assumptions about underreporting (see, e.g., Exs. 32-339-1-34, -36 and -43, Tr. 3588, Tr. 4306-07, 4308, 6336, 7362, 7522, as reported in AFL-CIO, Ex. 500-218). Other commenters, however, questioned the accuracy of OSHA's estimates of the extent of MSD underreporting (see, e.g., Exs. 500-197, 30-3845, 30-3813).

For example, Organizational Resources Counselors, Inc. (Ex. 30-3813) disagreed with OSHA's preliminary finding that MSDs are underreported on the grounds that: (1) The studies comparing workers' compensation data with OSHA Logs are more than a decade old; (2) OSHA's own audits (done in connection with

OSHA's Data Initiative) of employer injury and illness records indicates a "satisfactory" level of reporting; and (3) factors such as aging and off-the-job risks affect the onset of MSDs and complicate the accurate reporting of work-related MSDs. In response, OSHA notes that many of the reports and studies it is relying on as evidence of underreporting are recent (late 80's and 90's) and that in this section of the preamble (Significance of Risk), OSHA is relying only on those studies that report underreporting on the Log (and thus may affect the BLS survey results). OSHA believes that ORC's argument that establishing the work-relatedness of MSDs may make them difficult for employees to report accurately only reinforces OSHA's point: that they are underreported on the Log. Finally, although OSHA agrees that OSHA's Data Initiative audits show a relatively accurate level of Log reporting, it is important to note that they do show that lost-time injuries are underreported by close to 15%.

In response to OSHA's request in the proposal for specific information on the underreporting or overreporting of MSDs, the AFL-CIO submitted additional studies to the docket supporting the underreporting of work-related MSDs (Ex. 500-218). Representatives from the AFL-CIO support OSHA's statements in the proposed rule to the effect that the BLS survey understates the true magnitude of the MSD problem by a factor of two (64 FR 65981). The AFL-CIO states that the record demonstrates that MSDs are indeed significantly underreported, thus supporting OSHA's determination on this point (see Ex. 32-339-1 at pp. 3-4). Further, at the hearings several physicians and researchers confirmed that there is significant underreporting. (See, e.g., Dr. Armstrong, Tr. 839-40; Dr. Punnett, Tr. 1021; Dr. Erdil, Tr. 1115; Dr. Owen, Tr. 1886-87; Dr. Boden, Tr. 2399-2401.) Similarly, numerous workers explained that workplace injuries often go unreported to employers (Tr. 3588, 3602, 3612-13, 4510-11, 4587-89, 4595-97, 5601, 5820, 5861, 6068-69, 6381, 7546-7550, 7377-78, 7382-83, 7384-88, 7510-12, 7704). The AFL-CIO submitted testimony from Nancy Foley, a journalist from Massachusetts, concerning her fears and how that led her not to report her injury, as follows:

"In 1993, I began having pain in my neck and weakness in my hands. I did not seek medical attention until 1995 when the pain had spread into my left shoulder and left arm making it difficult for me to sit through the work day. Fear prevented me from seeking medical attention sooner. I was a part-time

reporter. And I was afraid I would never be made full-time if my employer knew the job was injuring me (Tr. 7318-9)."

NIOSH also agrees that the BLS data underestimate the true magnitude of the occupational injury and illness problem for two reasons: (1) Approximately one-third of industries are not included in the BLS annual survey, and (2) underreporting of the true number of work-related health problems on the OSHA 200 Logs occurs. NIOSH stated that while it is widely accepted that occupational disease is underestimated in the U.S., the OSHA 200 Logs are the major data source used by BLS to determine the extent of occupational disease in the United States. OSHA is persuaded by the evidence in the record that work-related MSDs are currently being substantially underreported on OSHA Logs. OSHA believes that the number of lost-time, work-related MSDs quantified in the Agency's risk assessment on the basis of the BLS data is understated by at least a factor of two.

Other Evidence Risks are Significant

In addition to the BLS data, epidemiologic studies comparing the prevalence or incidence of MSDs in exposed populations with the prevalence or incidence in referent groups with lesser or no such exposure also document the elevated risk confronting employees exposed to workplace risk factors. These studies also identify the types of workplace risk factors associated with the development of work-related musculoskeletal disorders, as well as the duration of exposures found to be associated with these disorders. This information further supports the occupational origin of the reported disorders.

For example, the odds of having an upper extremity disorder like carpal tunnel syndrome or tendinitis/peritendinitis of the shoulder or wrist are 5-30 times greater among workers exposed to combinations of risk factors such as high force, repetition and awkward postures (e.g., overhead work) than among either unexposed workers or workers who are exposed to a single risk factor (e.g., Luopajarvi *et al.*, 1979, Ex. 26-56; Armstrong *et al.*, 1987, Ex. 26-48; Silverstein *et al.*, 1987, Ex. 26-34; deKrom *et al.*, 1990, Ex. 26-41; Herberts *et al.*, 1984, Ex. 26-51). The odds of experiencing a low back disorder increased 3-8 fold among those workers exposed to frequent or forceful manual handling, awkward trunk postures (such as severe forward flexion), or to whole body vibration (Liles *et al.*, 1984, Ex. 26-33; Kelsey *et al.*, 1990, Ex. 26-52; Punnett *et al.*, 1991, Ex. 26-39; Wikstrom *et al.*, 1994,

Ex. 26–61; Tanaka *et al.*, 1995, Ex. 26–59). Hip and knee disorders are associated with heavy physical work and awkward postures, such as kneeling and squatting, or using the knee as a kicker. Thun *et al.* (1987, Ex. 26–60) reported an increased risk of bursitis in carpet-layers that was 5 times higher than that of the unexposed workers. In a review of 4 studies, Hagberg and Wegman (1987, Ex. 26–32) estimated the work-attributable fraction of shoulder tendinitis in the exposed population to be 90%. In a review of 15 cross-sectional and 6 case control studies of carpal tunnel syndrome, Hagberg *et al.* (1992, Ex. 26–50) estimated the work-attributable fraction in the population exposed to high force, high repetition, vibration or awkward wrist/hand postures to be 50–90%. Olsen *et al.* (1994, Ex. 26–57) estimated that 40% of the cases of coxarthrosis (osteoarthrosis of the hip) seen in the exposed working population was due to heavy physical workload. Thus, in general, strong and consistent associations have been identified in the epidemiologic literature, primarily in cross-sectional and case control studies, but also in prospective studies (*e.g.*, Kurppa *et al.*, 1991, Ex. 26–53; Riihimäki *et al.*, 1994 Ex. 26–58; Felson *et al.*, 1991, Ex. 26–49). Exposure-response relationships have been identified in a number of studies, although precise quantitative modeling is not yet available.

Based on the various data and studies discussed in the Quantitative Risk Assessment and Health Effects sections of the preamble, OSHA finds that workers exposed to workplace risk factors are at significant risk of developing work-related musculoskeletal disorders, which are harmful and often disabling conditions. This is particularly true for workers who are exposed to a combination of risk factors over most of the workshift.

The data indicate that this rule would, if promulgated, cause employers to implement, for their problem jobs, interventions that would reduce the exposure of at-risk workers to workplace risk factors, and thus would substantially reduce significant risk. Specifically, the requirements to conduct job analyses and implement controls where exposure to risk factors is high (*i.e.*, for jobs meeting the Action Trigger and/or identified as having MSD hazards) would help to ensure that employees are exposed to fewer risk factors over time, or to a combination of risk factors for a lesser amount of time, than is now the case. A large body of data demonstrates that workplace interventions, such as job analysis to

identify risk factors and implementation of controls to reduce exposures to these risk factors, can be very effective in reducing those forces responsible for musculoskeletal disease and injury; this has been shown in studies that have quantitatively examined the impact of ergonomic interventions on exposures to risk factors, as well as studies and reports that have documented actual reductions in injury prevalence following the implementation of ergonomics programs. Several of the standard's provisions, such as MSD management and training, will provide additional protection against the significant risk that will remain after controls are implemented in problem jobs.

C. OSHA's Response to Additional Comments

Several commenters argued that OSHA must quantify separately the risk posed by each hazard it is regulating (*i.e.*, force, awkward posture, vibration, repetition, and contact stress), and must do so in every industry below the two-digit SIC code level, in every occupational category, and in every job covered by the standard. See *e.g.*, Ex. 30–4499; Ex. 500–197; Ex. 500–187; 500–223.

In the Risk Assessment and Health Effects sections of this preamble, OSHA explained in detail its reasons for addressing these risk factors together in one standard. Substantial evidence in the rulemaking record demonstrates that these factors work together to pose a significant risk of material harm to employees. In most of the cohorts studied in the epidemiological literature examining these risk factors, the employees studied were exposed to combinations of the risk factors regulated; rarely would one of the risk factors be studied in isolation. In addition, substantial evidence in the rulemaking record indicates that ergonomic interventions are most effective when they examine an employee's exposure to all of the risk factors at issue at one time. The tools used to assess exposure to ergonomic risk factors are designed to account for interactions between risk factors. For example, the NIOSH lifting equation considers how forces applied by the worker (weight), the workers' posture, and lift frequency all interact to increase risk. Indeed, it would be inappropriate for OSHA to quantify the risk posed by each risk factor alone. Such an approach would not provide an accurate representation of the MSD hazard a particular employee faces when doing a certain job; indeed, such an approach would provide an inaccurate picture of

the MSD hazards present. The OSH Act's requirement are met if OSHA determines that employees are being subjected to a significant risk of material impairment of health or functional capacity by the risk factors being targeted and that the standard being promulgated will reduce that risk substantially. OSHA has done that here.

Using the best available evidence, OSHA has found that employees are currently exposed to a significant risk of material harm from the risk factors of force, repetition, awkward posture, contact stress, and vibration. The BLS data used by OSHA to calculate significant risk included Nature of Exposure Event Codes corresponding to these risk factors:

- Repetitive motion: This category reflects the risk factor of repetition; however, such exposure is often combined with force and/or posture.
- Overexertion: This category reflects the risk factor of force; however, such exposure is often combined with repetition and/or posture.
- Bodily reaction: This category reflects the risk factor of posture; however, such exposure is often combined with force or repetition.

While the BLS data did not directly include numbers reflecting exposures to the risk factors of vibration and contact stress, OSHA believes that some of the MSDs included in the data may also have involved exposure to these hazards. Other evidence in the rulemaking record also convincingly shows that employees exposed to these two risk factors experience a significant risk of material harm. A number of epidemiological studies in the rulemaking record demonstrate that exposure to vibration at even low levels causes a number of serious conditions, including hand-arm vibration syndrome. See the discussion of vibration in the Health Effects section; see also Ex. 26–392. Indeed, NIOSH specifically found this in its 1997 review of the epidemiological literature. See Ex. 26–1. There is also substantial evidence in the rulemaking record that contact stress as defined by this standard can cause a significant risk of material harm. As discussed fully in the Health Effects section, the scientific literature strongly shows that contact stress causes such conditions as hypothyroidism, hammer syndrome and carpet layers' knee. Thus, there is no question that workers are currently exposed to a significant risk of material harm from the risk factors of force, repetition, vibration, awkward posture, and contact stress.

OSHA is also not required to conduct its significant risk analysis at a detailed

industry level, or by occupational category or job. Where a standard requires employers to act only when the hazards being regulated are present in their workplace, OSHA has no duty to disaggregate risk in this manner. See *International Union, United Auto Workers v. OSHA* (LO/TO II), 37 F.3d 665, 670 (D.C. Cir. 1994). This was recently confirmed by the D.C. Circuit in its review of OSHA's Lockout/Tagout standard. In the Lockout/Tagout rulemaking, OSHA found that workers performing certain operations across general industry were exposed to a significant risk of material harm from the hazard of energy unexpectedly being released from certain powered industrial equipment. *Id.* at 667. Certain industry challengers argued that OSHA was under a duty to disaggregate the risk faced by workers by SIC code, particularly since, they contended, there was zero risk in certain SIC codes. The court held that the OSH Act placed no such duty on OSHA: "If, as OSHA asserts * * * the regulation applies simply to *machines* that pose a significant risk and to workers subjected to that risk, we see no reason why OSHA should be concerned with industry classifications that appear essentially irrelevant to its task." *LO/TO II*, 37 F.3d at 670 (emphasis added). See also *Associated Builders and Contractors, Inc. v. OSHA*, 862 F.2d 63, 68 (3d Cir. 1988) ("A requirement that the Secretary assess risk to workers and need for disclosure with respect to each substance in each industry would effectively cripple OSHA's performance of the duty imposed on it * * *"); *American Dental Ass'n v. Martin*, 984 F.2d 823, 827 (7th Cir. 1993) ("[T]he agency [is not] required to proceed workplace by workplace, which in the case of bloodborne pathogens would require it to promulgate hundreds of thousands of separate rules.").

Like OSHA's Lockout/Tagout rule, this standard is not "industry-based." An employer is required to respond to an employee report of signs or symptoms of an MSD only when the employer determines that an "MSD incident" has occurred and the employee's job is one that contains risk factors that exceed the standard's screen. OSHA is not triggering industry wide obligations; rather, it is triggering obligations on employers where there are ergonomic hazards present at certain levels in jobs in their workplace. Under these circumstances OSHA is not required to disaggregate risk by three or four digit SIC code, or by occupational category, or by jobs potentially covered by the standard.

Several commenters argued that because MSDs are not fatal, OSHA should deviate from its past practice of considering as "significant" a "one in a thousand" risk that a worker will develop an MSD over a working lifetime. See *e.g.*, Ex. 500-223.

As noted above, a plurality of the Supreme Court in *Benzene* held that, although "it is OSHA's responsibility to determine, in the first instance, what it considers to be a 'significant' risk, * * * the requirement that a 'significant' risk be identified is not a mathematical straitjacket * * * [and] the Agency has no duty to calculate the exact probability of harm." *Id.* at 655. While the Court noted OSHA's broad discretion to formulate what level of risk it considers to be significant, the Court also provided guidance to OSHA as to what a reasonable person might consider a significant risk of material harm:

"Some risks are plainly acceptable and others are plainly unacceptable. If, for example, the odds are one in a billion that a person will die from cancer by taking a drink of chlorinated water, the risk clearly could not be considered significant. On the other hand, if the odds are one in a thousand that regular inhalation of gasoline vapors that are 2 percent benzene will be fatal, a reasonable person might well consider the risk significant and take the appropriate steps to decrease or eliminate it." *Id.* at 655.

In past standards, OSHA has applied that guidance, noting that a risk of one in a thousand of dying from an occupational exposure is significant. However, OSHA has never quantified the lowest level of risk of death that it considers significant, beyond acknowledging that the level must be higher than one in a billion. Thus it is not true that OSHA takes the position that a risk of dying is necessarily insignificant if it is less than one in a thousand.

OSHA has only infrequently quantified the risks of nonlethal harm from workplace exposures. It recognizes, however, that a reasonable person might well be willing to accept a greater risk of injury than of death, and that there may be cases where even a risk of one in a thousand of some types of injuries occurring is insignificant. OSHA need not determine whether this is such a case, however, because, throughout general industry, the working lifetime risk of developing an MSD is extraordinarily high. OSHA has found working lifetime risks to be as high as 835 per thousand (Transportation by air), 486 per thousand (Local and suburban transit and interurban highway passenger transportation), and 206 per thousand

(Real estate). Even in SIC code 62 (Security and Commodity Brokers, Dealers, Exchanges, and Services), the SIC code with the lowest risk, 24 out of 1,000 workers are likely to suffer at least one MSD during a working lifetime. These risk levels are extremely high by any measure or formulation and are clearly "significant" under the OSH Act. Further, the serious and often disabling nature of these disorders is attested to by the fact that their severity (measured by median number of days away) is greater than median for all other injuries and illnesses combined.

Some commenters argued that the standard is improperly structured to reduce all risk, even insignificant risk. See Exs. 30-4185; 30-3951. OSHA agrees that this standard will substantially reduce the significant risk of material harm faced by workers from exposure to ergonomic risk factors. OSHA estimates that the standard will reduce the number of lost workday MSDs currently reported to the BLS by approximately 50%. This amounts to approximately 300,000 MSDs a year and constitutes a substantial reduction in the number of MSDs experienced by workers every year across general industry. This standard is not designed to reduce "insignificant" risk, however. OSHA has made some changes to the standard (from the proposed rule) to ensure that employers are not required to act when the risk posed to their employees from the risk factors at issue is below certain levels.

First, OSHA has included a screen in the standard that will ensure that employers are not required to act in the absence of "significant risk." OSHA established the screen based on substantial evidence in the rulemaking record showing substantial excess risk of developing MSDs above the hazard levels in the screen. If employees are exposed to the risk factors at issue below the levels indicated by the screen, employers have no obligations to analyze their jobs, implement controls, or train their workers.

Second, OSHA has not included the proposed incremental abatement process in the final standard. As explained more thoroughly in section IV, above, the incremental abatement process would have allowed employers to incrementally implement controls to certain jobs to materially reduce MSD hazards. If continued exposure to certain hazards in the job prevented an injured employee from recovering, the employer was required to implement additional feasible controls. Although this approach mirrored what many employers were currently doing in their ergonomics programs, it was highly